# SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

Minor (Odd Semester) – 2019-20

B.Tech. || ME || Sem III

## Thermodynamics

Subject Code: MEL-1211

**Time allowed: 1.5 Hrs** **Max Marks: 30**

1 A reversible heat engine absorbs 2500 kJ/cycle of heat from a constant temperature heat source at 2000 K and rejects some energy as waste heat to a reservoir X. The work output from the engine is used to drive a reversible refrigerator; its source temperature being 300 K. The heat outflow from the refrigerator is also taken to reservoir X. If the total heat flow into the reservoir is 3000 kJ/cycle, make the calculations for temperature of reservoir X. (5)

2 State the limitations of first law of thermodynamics (2)

3 A centrifugal pump delivers 2750 kg of water per minute from initial pressure of 0.8 bar absolute to a final pressure of 2.8 bar absolute. The suction is 2 m below and the delivery is 5 m above the center of pump. If the suction and delivery pipes are of 15 cm and 10 cm diameter respectively, make the calculations for the power required to run the pump (5)

4 Three Carnot engines E1,E2 and E3 operate between temperatures of 1000 K and 300 K. Make calculations for the intermediate temperatures if the work produced by the engines are in the ratio of 4:3:2. (5)

5 One kg of air at 1 bar and 300 K is compressed adiabatically till its pressure becomes 5 times the original pressure. Subsequently it is expanded at constant pressure and finally cooled at constant volume to return to its original state. Calculate the heat and work interactions, and change in internal energy for each process and for the cycle. (5)

6 Develop the following expression (3)

$$Q_{1-2} = \frac{\gamma - n}{\gamma - 1} \times \text{polyropic work done}$$

7 Explain the concept of clausius inequality for reversible and irreversible heat engines (5)